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**CLAIMS**

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**[Claim(s)]**

[Claim 1] Environmental recognition equipment characterized by having an image display means to display the image which deducted the visible-ray image picturized with said visible-ray camera from the infrared image picturized by the infrared camera which picturizes a surrounding environment condition using infrared radiation, said infrared camera and the visible-ray camera which picturizes the environment condition in the same location using a visible ray mostly, and said infrared camera.

[Claim 2] Environmental recognition equipment characterized by what said infrared camera, visible-ray camera, and image display means are carried in the car, respectively, it is set up in claim 1 so that said infrared camera and visible-ray camera may picturize the environment condition ahead of a car, respectively, and said image display means is formed for in the location which can be viewed by the operator.

[Claim 3] An ambient light measurement means to measure the ambient light of a light region in claim 1, A reflected light measurement means to measure the reflected light from said visible-ray camera, and a reflection factor calculation means to compute the reflection factor in a light region based on the output from said ambient light measurement means and a reflected light measurement means, An infrared reflection factor presumption means to presume the reflection factor in an infrared region based on the reflection factor computed by said reflection factor calculation means, It is based on an ambient light measurement means for infrared radiation to measure the ambient light of an infrared region, and the infrared reflection factor presumed by said infrared reflection factor presumption means and the ambient light of the infrared region measured by said ambient light measurement means for infrared radiation. It is based on the amount of infrared reflection presumed by amount presumption means of infrared reflection to presume the amount of reflection in an infrared region, and the amount of infrared emission measured by said infrared camera and said amount presumption means of infrared reflection. Environmental recognition equipment characterized by having a body radiant-quantities presumption means to presume objective radiant quantities, and an image transformation means to change into an image the body radiant quantities presumed by said body radiant-quantities presumption means.

[Claim 4] Environmental recognition equipment with which the image which comes to add the image with which body radiant quantities deducted the field more than the specified quantity from the light image to the image based on said body radiant quantities in claim 3 is characterized by what is displayed on said image display means.

[Claim 5] Environmental recognition equipment characterized by the thing change the concentration of the image displayed on said image display means based on concentration distribution of an infrared image in claim 1, and he is trying to raise contrast for.

[Claim 6] Environmental recognition equipment characterized by the thing it is made to make the edge of the image displayed on said image display means based on the edge reinforcement of an infrared image emphasized in claim 1.

[Claim 7] Environmental recognition equipment with which a specific body is chosen based on the processing result of the image picturized with said visible-ray camera, and the this chosen specific body

is characterized by what is displayed on said image display means in claim 1.

[Claim 8] Environmental recognition equipment with which a specific body is chosen based on the distance display from a laser radar, and the this chosen specific body is characterized by what is displayed on said image display means in claim 1.

[Claim 9] Environmental recognition equipment with which a specific body is chosen based on the information from an external-environment detection means to be except said each camera and to detect an external environment in claim 1, and the this chosen specific body is characterized by what is displayed on said image display means.

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TECHNICAL FIELD

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[Field of the Invention] This invention relates to the environmental recognition equipment which enabled it to recognize a perimeter environment clearly using an infrared camera and a visible-ray camera.

[0002] For example, if it is in vehicles, such as a vessel, a train, and an automobile, displaying the front environment condition which to recognize a front situation, i.e., a front environment condition, clearly was desired, and was picturized with the camera for security for this reason on the location which is easy to view to an operator is performed. When it considers as the visible-ray camera which picturizes a camera using a visible ray, it is easy to become inadequate by the glare of the road which does not have lighting at the time of SIGMET, such as Nighttime, and rain, fog, snow, or an oncoming car recognizing [ of pedestrian's existence recognition, the change of a situation of a front transit way, etc. ].

[0003] Moreover, using the infrared camera picturized using infrared radiation as a camera is indicated by JP,2-158900,A. When this infrared camera is used, it becomes possible also in the time of Nighttime, or the time of SIGMET to picturize a front body, and becomes advantageous from the case where it picturizes with a visible-ray camera.

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**TECHNICAL PROBLEM**

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[Problem(s) to be Solved by the Invention] Even if it is possible to detect a high thermal radiation body like a pedestrian or an oncoming car when it pictures with an infrared camera, it becomes what distinction with a low thermal radiation body like the transit partition line (white line) drawn, for example on the road surface cannot attach sufficiently easily, and it will become difficult to recognize a perimeter environment enough only by the image pictured with the infrared camera.

[0005] This invention took the above situations into consideration, and was made, and the purpose is in offering the environmental recognition equipment which enabled it to recognize more clearly existence of the body which is in a perimeter environment also in the time of Nighttime or the time of SIGMET, and which poses especially an insurance top problem.

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**MEANS**

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[Means for Solving the Problem] In order to attain said purpose, if it is in this invention, the following solution technique is adopted. That is, it should have an image display means to display the image which deducted the visible-ray image picturized with said visible-ray camera, like from the infrared image picturized by the infrared camera according to claim 1 in a claim which picturizes a surrounding environment condition using infrared radiation, said infrared camera and the visible-ray camera which picturizes the environment condition in the same location using a visible ray mostly, and said infrared camera. The desirable mode on condition of the above-mentioned solution technique is as a two or less claim [ in a claim ] publication.

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## DESCRIPTION OF DRAWINGS

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### [Brief Description of the Drawings]

[Drawing 1] Drawing showing a camera when this invention is applied to an automobile, and the example of arrangement of a display.

[Drawing 2] Drawing showing the desirable example of a setting of a camera, a display, and an operator location.

[Drawing 3] Drawing showing other desirable examples of a setting of a camera, a display, and an operator location.

[Drawing 4] The simple schematic diagram showing an example of a camera head.

[Drawing 5] The simple schematic diagram showing other examples of a camera head.

[Drawing 6] The explanatory view showing the desirable example of a setting of a display prepared in the window.

[Drawing 7] A control schematic diagram in order [ whole ] to obtain the display image displayed on a display based on an infrared image visible-ray image.

[Drawing 8] The schematic diagram showing the contents by which an image processing is carried out based on an infrared image and a visible-ray image.

[Drawing 9] The schematic diagram for presuming body radiant quantities.

[Drawing 10] The explanatory view showing the reflective situation of a visible ray.

[Drawing 11] The explanatory view showing an infrared reflective situation.

[Drawing 12] Drawing showing the lens system of a visible-ray camera.

[Drawing 13] The simple side elevation showing an example for maintaining the lens of an infrared camera to predetermined temperature.

[Drawing 14] Drawing when seeing the lens of drawing 13 from a transverse plane.

[Drawing 15] Drawing showing an example which carries out an image processing based on the concentration of an infrared image.

[Drawing 16] Drawing showing an example which carries out an image processing based on the concentration of an infrared image.

[Drawing 17] Drawing showing an example which carries out an image processing based on the concentration of an infrared image.

[Drawing 18] Drawing showing an example which carries out the image processing of the infrared image based on secondary differential.

[Drawing 19] Drawing showing an example which carries out the image processing of the infrared image based on secondary differential.

[Drawing 20] Drawing showing an example which carries out the image processing of the infrared image based on secondary differential.

[Drawing 21] Drawing showing the example of a setting of a secondary differentiation filter.

[Drawing 22] Drawing showing other examples of a setting of a secondary differentiation filter.

[Drawing 23] Drawing showing another example which carries out the image processing of the infrared image based on secondary differential.

[Drawing 24] Drawing showing another example which carries out the image processing of the infrared image based on secondary differential.

[Drawing 25] Drawing showing another example which carries out the image processing of the infrared image based on secondary differential.

[Drawing 26] Drawing showing another example in the pan which carries out the image processing of the infrared image based on secondary differential.

[Drawing 27] Drawing showing another example in the pan which carries out the image processing of the infrared image based on secondary differential.

[Drawing 28] Drawing showing another example in the pan which carries out the image processing of the infrared image based on secondary differential.

[Drawing 29] Drawing showing the example of a setting of the correction value of the secondary differential in the example of drawing 26 - drawing 28 .

[Drawing 30] Drawing showing the example which amends an infrared image based on a visible-ray image.

[Drawing 31] Drawing showing the example which amends an infrared image using a laser radar.

[Drawing 32] Drawing showing the example which amends an infrared image using an external sensor.

[Drawing 33] Drawing showing the contents of amendment of drawing 32 .

[Description of Notations]

One automobile

Two camera heads

The controller for 4 image composition

7HUD (HUD equipment)

7a display

13 infrared cameras

14 visible-ray camera

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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]****[0001]**

**[Field of the Invention]** This invention relates to the environmental recognition equipment which enabled it to recognize a perimeter environment clearly using an infrared camera and a visible-ray camera.

**[0002]** For example, if it is in vehicles, such as a vessel, a train, and an automobile, displaying the front environment condition which to recognize a front situation, i.e., a front environment condition, clearly was desired, and was picturized with the camera for security for this reason on the location which is easy to view to an operator is performed. When it considers as the visible-ray camera which picturizes a camera using a visible ray, it is easy to become inadequate by the glare of the road which does not have lighting at the time of SIGMET, such as Nighttime, and rain, fog, snow, or an oncoming car recognizing [ of pedestrian's existence recognition, the change of a situation of a front transit way, etc. ].

**[0003]** Moreover, using the infrared camera picturized using infrared radiation as a camera is indicated by JP,2-158900,A. When this infrared camera is used, it becomes possible also in the time of Nighttime, or the time of SIGMET to picturize a front body, and becomes advantageous from the case where it picturizes with a visible-ray camera.

**[0004]**

**[Problem(s) to be Solved by the Invention]** Even if it is possible to detect a high thermal radiation body like a pedestrian or an oncoming car when it picturizes with an infrared camera, it becomes what distinction with a low thermal radiation body like the transit partition line (white line) drawn, for example on the road surface cannot attach sufficiently easily, and it will become difficult to recognize a perimeter environment enough only by the image picturized with the infrared camera.

**[0005]** This invention took the above situations into consideration, and was made, and the purpose is in offering the environmental recognition equipment which enabled it to recognize more clearly existence of the body which is in a perimeter environment also in the time of Nighttime or the time of SIGMET, and which poses especially an insurance top problem.

**[0006]**

**[Means for Solving the Problem]** In order to attain said purpose, if it is in this invention, the following solution technique is adopted. That is, it should have an image display means to display the image which deducted the visible-ray image picturized with said visible-ray camera, like from the infrared image picturized by the infrared camera according to claim 1 in a claim which picturizes a surrounding environment condition using infrared radiation, said infrared camera and the visible-ray camera which picturizes the environment condition in the same location using a visible ray mostly, and said infrared camera. The desirable mode on condition of the above-mentioned solution technique is as a two or less claim [ in a claim ] publication.

**[0007]**

**[Effect of the Invention]** According to claim 1, even if it is at the night and SIGMET time, human being and the vehicle which are a high thermal radiation body with an infrared camera by being able to

supplement clearly and deducting an image pick-up, i.e., the image moreover obtained with the visible-ray camera Contrast can be enough attached with the other thing and human being and the vehicle which pose a problem especially on insurance can be displayed, and it will become desirable when making a required body display that is, recognize clearly on insurance.

[0008] According to claim 2, in an automobile, when recognizing a front situation clearly, it will become desirable. According to claim 3, the specific body which is a high thermal radiator can be recognized and displayed more clearly.

[0009] According to claim 4, to the image obtained by the infrared camera, although it cannot fully supplement, the image with which it is clearly supplemented depending on a visible-ray camera is added, and with an infrared camera, the image which employed the advantage of both cameras efficiently as a whole can be displayed. According to claim 5 and claim 6, it will become desirable when raising the recognition degree of the image displayed considering the image displayed as what contrast was emphasized more as.

[0010] According to claim 7, with an infrared camera, although clearly picturized that is, supplemented with a visible-ray camera, when displaying clearly the specific body with which it picturizes that is, is sufficiently hard to be supplemented, it will become desirable. According to claim 8, it will become desirable when displaying clearly the specific body in the predetermined distance measured with a laser radar. According to claim 9, it will become desirable when displaying clearly the specific body from which the image picturized according to the external environment tends to change.

[0011]

[Embodiment of the Invention] In drawing 1, the camera head 2 for picturizing the environmental situation ahead of an automobile in the front end section of an automobile 1 is equipped. This camera head 2 has the infrared camera and the visible-ray camera so that it may mention later. The image by which the image pick-up direction (camera location) was controlled by the camera controller 3, and the camera head 2 was picturized with each camera obtains the controller 4 composition / for image processings, and is inputted into HUD (HUD equipment)7. HUD7 controls display 7a as the image display section prepared in the window 6 which is ahead of [ direct ] a driver's seat.

[0012] Drawing 2 shows the desirable example of a setting of a camera head 2 (camera) and display 7a. In this drawing 2, the cross-direction center line of a car body is shown by Agreement OBL, it is parallel to this OBL, and the look center line passing through an operator's core (core on a look) is shown by Agreement IL. A camera head 2 and display 7a are set up, respectively so that the core may be located on the look center line IL. and the angle of visibility of a camera head 2 -- a core [ center line / IL / look ] -- right and left -- it is set as the same magnitude. A sense of direction when the display image and operator who are detected by the camera head 2 by such setup, and are displayed on display 7a actually view a front body can be made in agreement.

[0013] Drawing 3 shows the modification of drawing 2. Namely, since the direction angle of visibility of a passenger side usually becomes large rather than the direction angle of visibility of a drivers side, corresponding to the difference of the angle of visibility of right and left of this operator, as for the visual field of right and left of an operator, the magnitude of the angle of visibility of right and left of a camera head 2 is set up. Thus, although the angle of visibility of a camera head 2 and an operator's angle of visibility will be in agreement when it sets up, it will be different in the time of the image and operator as whom a sense of direction on either side was displayed on display 7a actually viewing a front body, while they had made the core of display 7a in agreement with the visual field line IL. In order to cancel such a difference, the core of display 7a is made to offset to a passenger side with a large angle of visibility, and the display 7a concerned is arranged.

[0014] As for drawing 4, the example of a camera head 2 is shown. In this drawing 4, 11 is camera housing, and although a visible ray is reflected in that interior, the mirror 12 which passes infrared radiation, the infrared camera 13 picturized using infrared radiation, and the visible-ray camera 14 picturized using a visible ray are equipped. After the light from the front passes the protection filter 15 which penetrates both a visible ray and infrared radiation, while only a visible ray is deflected 90 abbreviation by the mirror 12 and it is inputted into the visible-ray camera 14, the infrared radiation

which passed the mirror 12 is inputted into an infrared camera 12. The visible-ray camera 14 is carried in the universal head 16 which can be justified in 3 shaft orientations, and fine tuning of optical-axis doubling with an infrared camera 13 of it is enabled.

[0015] Drawing 5 shows the modification of drawing 4. In the example of this drawing 5, 12A and two kinds of 12B are used as a mirror. Although mirror 12A located ahead reflects a visible ray, it is what passes infrared radiation, and the visible ray reflected 90 abbreviation by mirror 12A is inputted into the visible-ray camera 14. Moreover, mirror 12B located back reflects infrared radiation, and the infrared radiation which passed mirror 12A is reflected in the same direction as mirror 12A 90 abbreviation, and it is inputted into an infrared camera 13. In addition, the visible-ray camera 14 is carried in universal-head 16A which can be justified in 3 shaft orientations, an infrared camera 13 is carried in universal-head 16B which can be justified in 3 shaft orientations, and optical-axis doubling with both the cameras 13 and 14 is performed by adjusting the universal heads 16A and 16B of these both.

[0016] Drawing 6 is the desirable example of a setting of HUD7, and an operator enables it to have checked clearly by looking the image displayed on the window 6 ahead of [ direct ] an operator by HUD7, without being especially interfered from a front car etc. to disturbance light. That is, while display 7a which becomes window 6 inside ahead of [ direct ] an operator from a high reflective coat is prepared, in the direct front location of display 7a, the protection-from-light components 17, such as liquid crystal and EC, are put. By controlling the energization to this protection-from-light component 17, adjustment of the level of protection from light by the protection-from-light component 17 is enabled. For protection-from-light level adjustment, the photosensor 18 which detects the disturbance intensity of light is formed in the window 6 near display 7a, and the detecting signal in the optical sensor 18 is inputted into the controller 19 for protection-from-light component 17. It controls the energization to the protection-from-light component 17 so that a controller 19 has a strong disturbance light detected with a photosensor 18, and the protection-from-light level of the protection-from-light component 17 becomes strong.

[0017] Drawing 7 shows an example of the image-processing circuit which compounds the image picturized with the infrared camera 13, and the image picturized with the visible-ray camera 14, and is displayed by display 7a, and is equivalent to the contents of the controller 4 in drawing 1. In this drawing 7, after the image pick-up signal from the visible-ray camera 14 is reversed by the image turnover device 21, processing of alignment with the image picturized with the infrared camera 13 is performed, and the image after this alignment processing is inputted into the image synthesizer unit 23 by alignment equipment 22. The image picturized by the infrared camera 13 will also be inputted into this image synthesizer unit 23, and it will be compounded so that the image picturized with both the cameras 13 and 14 may mention later with the synthesizer unit 23 concerned.

[0018] The synthetic image from a synthesizer unit 23, the signal from alignment equipment 22, and the image pick-up image from an infrared camera 13 are inputted into the recognition processor 24. Although the synthetic image in a synthesizer unit 23 is processed in the recognition processor 24 so that it may be easy to recognize an operator and may mention later, a synthetic level signal is outputted from this recognition processor 24 to a synthesizer unit 23, and a synthesizer unit 23 compounds the image pick-up image in both the cameras 13 and 14 as it is also at the level according to the synthetic level signal inputted. The synthetic image from a synthesizer unit 23 and the recognition result from the recognition processor 24 are inputted into image processing equipment 25, and the image after processing with this processing equipment 25 (the image in the condition which can be viewed to an operator is processed) is outputted to HUD7 (displayed on display 7a).

[0019] Drawing 8 shows the contents of control of this invention in graph, and is equivalent to the functional contents of a synthesizer unit 23 and the recognition processor 24 in drawing 7. First, although the image picturized with the visible-ray camera 14 is shown by G1, the oncoming car 31 (in drawing 8, only the headlight in a lighting condition has attached agreement 31a) which made headlight 31a turn on, the pedestrian 32 who is in the side of an oncoming car 31, and the white line 33 used as the partition line of a transit way are picturized. However, although it is Nighttime, and headlight 31a and a white line 33 are clearly picturized since it is dark in near a pedestrian 32 (a continuous line shows), the

body profile of an oncoming car 31 and a pedestrian 32 can hardly be identifying (it is in a very dark condition and a broken line shows). In addition, the body profile of an oncoming car 31 is somewhat clearer than a pedestrian 32.

[0020] The image picturized by the infrared camera 13 is shown as G2. By this image G2, although the pedestrian 32 and the body profile of an oncoming car 31 which are a high temperature radiator are picturized clearly, the white line 33 which is a low-temperature radiator is not being picturized at all. Especially image G3 is what emphasizes and displays a pedestrian 32. This sake, As opposed to the image which deducted the image G1 from the image G2 (total processing by the subtraction processor 35) processing (recognition processor 24) which specifies especially the pedestrian 32 was performed, and only the pedestrian 32 was displayed as a specific body (for this reason, reflection factor presumption which presumes that a reflection factor mentions later based on the reflected light from the visible-ray camera 14 -- processing of 34 is performed).

[0021] The image G4 is the image which compounded and obtained each images G1 and G2 and G3 (addition processing by the addition processor 36). More specifically, the image (a white line 33 is considerable) with which body radiant quantities deducted the thing (an oncoming car 31 corresponds with a pedestrian 32) of the field more than the specified quantity from the image G1 is added to an image G2. And image G3 is further added to the added image, and an image G4 is obtained. Thereby, the pedestrian 32 was emphasized, especially the image G4 was displayed very clearly, the oncoming car 31 was also displayed quite clearly, where headlight 31a is turned on, and the white line 33 was also displayed further clearly.

[0022] Here, image G3 can also be displayed on HUD7. Moreover, the image which deducted the image G1 from the image G2 can also be displayed on HUD7 (display of the image with which only the oncoming car 31 used as a high temperature radiator and the pedestrian 32 were emphasized). Furthermore, the image adding the part (a white line 33 corresponds in a field) currently clearly displayed only by the image G1 can also be displayed on HUD7 to an image G2 (the same condition as the image of the oncoming car 31 in the - image G2 by which the body profile becomes clearer in an image G4 although headlight 31a of an oncoming car 31 will be in the condition near a putting-out-lights condition).

[0023] Drawing 9 presumes body radiant quantities (objective discernment is possible by being the amount of infrared emission of the proper which a body has, and getting to know these body radiant quantities) based on the reflection factor from the body of a visible ray, and shows the technique of displaying a specific body on HUD7 from body radiant quantities. That is, based on the ambient light of the light region measured by the measurement means 41, and the reflected light measured with the visible-ray camera 14, the reflection factor in a light region is computed by the calculation means 42. Based on the reflection factor in the computed light region, the reflection factor in an infrared region is presumed by the presumed means 43.

[0024] On the other hand, based on the reflection factor presumed to be the ambient light of the infrared region measured by the measurement means 44 by the presumed means 43, the amount of reflection in an infrared region is presumed by the presumed means 45. Based on the radiant quantities measured by the infrared camera 13, and the presumed radiant quantities in the presumed means 45, body radiant quantities are presumed by the presumed means 46. And based on the body radiant quantities presumed by the presumed means 46, image transformation is carried out by the image transformation means 47 (image transformation to a specific body peculiar to body radiant quantities), and this image by which image transformation was carried out is displayed on HUD7.

[0025] An example of the concrete presumed technique for obtaining the body radiant quantities in drawing 9 is explained referring to drawing 10 - drawing 12 and the following formulas 1 - a formula 18. First, drawing 10 shows the reflective situation of the visible ray from a body (photographic subject), and the reflected light when ambient light is reflected by the body is dependent on an objective surface characteristic (whenever [ reflection factor and angle-of-reflection ]). On the other hand, drawing 11 will show the reflective situation of the infrared radiation from a body (photographic subject), and the value to which the amount of reflection when ambient light is reflected by the body, and the radiant quantities

from a thing with a body were added will be detected by the infrared camera 13. However, it is the same as a visible ray that it is dependent on an objective surface characteristic (whenever [ reflection factor and angle-of-reflection ]) of the amount of reflection when reflective \*\* of the ambient light is carried out by the body also in the case of infrared radiation.

[0026] Drawing 12 shows the optical system which will be the requisite when computing the reflection factor of a visible ray, in this drawing 12, an objective reflection factor is set to R, sets area to A, illuminates a body by the flux of light FO, and is the f number FN. Only distance l detaches a lens and it has placed. m, then an image carry out image formation of the scale factor of an image to the location of ml from a lens, and area is set to m2 A. At this time, flux of light F [lm] which carries out incidence to an image pick-up side comes to be shown in a formula 1.

[0027]

[Equation 1]

$$F = \frac{F_0 R T_L}{4 F_N^2} \cdot \frac{m^2}{(1+m)^2} \quad [lm]$$

[0028] The flux of light Fd which it is reflected from a body and emitted to a unit solid angle It comes to be shown in a formula 2.

[0029]

[Equation 2]

$$F_d = \frac{F_0 R}{\pi}$$

[0030] Since an image pick-up side is arrived at, all the flux of lights that pass along lens diaphragm 2r are Fd. The solid angle which a diaphragm stretches is imposed and it multiplies by lens permeability (formula 3).

[0031]

[Equation 3]

$$F = F_d \frac{\pi r^2 T_L}{l^2} = \frac{F_0 R T_L r^2}{l^2}$$

[0032] If the focal distance of a lens is set to f, the relation of a formula 4 will be materialized to the f number of the lens mentioned above, and a lens scale factor.

[0033]

[Equation 4]

$$\frac{1}{l} + \frac{1}{d} = \frac{1}{f}$$

[0034] Furthermore, the relation between the following formula 5 - a formula 8 is materialized.

[0035]

[Equation 5]

$$\frac{m+1}{m} \cdot f = l$$

[0036]

[Equation 6]

$$F = \frac{F_0 R T_L}{4 F_N^2} \cdot \frac{m^2}{(m+1)^2}$$

[0037]

[Equation 7]

$$E_0 = \frac{F_0}{A} \quad , \quad E = \frac{F}{B} = \frac{F}{m^2 A}$$

[0038]

[Equation 8]

$$E = \frac{E_0 R T_L}{4 F_N^2 (m+1)^2} \quad [1x]$$

[0039] In an ordinary image pick-up, a formula 9 is materialized noting that  $l$  is larger than  $m$  enough, since the distance  $l$  from a lens to a photographic subject is longer than the distance to an image pick-up side enough.

[0040]

[Equation 9]

$$E \approx \frac{E_0 R T_L}{4 F_N^2} \quad [1x]$$

[0041] It is ES about the illuminance of measurable ambient light. If it carries out, it is the presumed reflection factor RS. It is shown in a formula 10.

[0042]

[Equation 10]

$$R_S = \frac{E_0}{E_S} = \frac{(E_S T_L)^{1/2}}{2 F_N \cdot E^{1/2}}$$

[0043] About  $E$  in a formula 10, since an actual camera output is NTSC, it will compute from the quantity of state (gain, offset, gamma correction value) of a camera.

[0044] The above-mentioned presumed reflection factor RS Although it is based and the reflection factor in an infrared region is presumed, a body shall not be a selective radiator as the premise (not almost all bodies are selective radiators and especially metals, such as a pedestrian and the automobile body, are not selective radiators). Thereby, it is the reflection factor RI in an infrared region. Reflection factor RS in a visible-ray region It is shown like a formula 11 as a function.

[0045]

[Equation 11]

$$R_I = F(R_S)$$

[0046] It is IS about the circumference radiant quantities of a measurable infrared region. Reflective component IR from the body by which incidence will be carried out to an infrared camera 13 if it carries out It comes to be shown in a formula 12.

[0047]

[Equation 12]

$$I_R = R_I \cdot I_S$$

[0048] The output value  $I$  of an infrared camera 13 to IR If it subtracts, they will be the radiant quantities IO of a body proper. It asks (formula 13).

[0049]

[Equation 13]

$$I_O = I - I_R$$

[0050] If the above processing is performed in the whole image, they are the body proper radiant quantities IO. An image is created. This IO By carrying out field division of the image, discernment of the body by the difference in the quality of the material (front face) can be performed. About the body of

known [ emissivity / temperature and ], it is IO. It is possible to extract without performing the shape recognition to an image. The radiant quantities from a body are calculated by using the formula of a plank only depending on temperature and wavelength. wavelength lambda 1 from -- lambda 2 When it picturizes with the infrared camera 13 with sensibility, the formula of a plank is shown as shown in a formula 14.

[0051]

[Equation 14]

$$M_{\lambda} = \frac{2 \pi h c^2}{\lambda^5} \frac{1}{e^{c h / \lambda k T} - 1} \quad [W \cdot c m^{-2} \cdot \mu m^{-1}]$$

[0052] Use of that the ratio of M to the wavelength of two pieces is the product of lambda and T forms a formula 15.

[0053]

[Equation 15]

$$M_{\lambda_1 \sim \lambda_2} = \left( \frac{M_{0 \sim \lambda_2}}{M_{0 \sim \infty}} - \frac{M_{0 \sim \lambda_1}}{M_{0 \sim \infty}} \right) M_{0 \sim \infty}$$

[0054] The degree type 16 shown in the formula 15 is the function of only the product of lambdaT, and is given in a numerical table.

[0055]

[Equation 16]

$$\frac{M_{0 \sim \lambda}}{M_{0 \sim \infty}}$$

[0056] The denominator in a formula 16 is called for by the formula of Stephen Boltzmann shown in a formula 17.

[0057]

[Equation 17]

$$M = \frac{2 \pi^5 k^4}{15 c^3 h^3} T^4 \quad [W \cdot c m^{-2}]$$

[0058] Here, it is the reflection factor RI in an infrared region. Finally it will be shown by the formula 18 (a field with the property of RI can be extracted).

[0059]

[Equation 18]

$$\frac{I_0}{M_{\lambda_1 \sim \lambda_2}} = R_I$$

[0060]

[0061] Drawing 13 and drawing 14 show the case where it enables it to picturize appropriately with an infrared camera 13, irrespective of a temperature environment. That is, temperature management of that camera sensor part is carried out so that it may become predetermined temperature, but since the lens part is designed in ordinary temperature, an infrared camera 13 can usually consider producing the case where originate in the temperature change of this lens part, and an image pick-up is not performed good. In order to prevent such a situation, the temperature sensor 52 which detects the temperature of wrap one side and a lens part for a lens part by the attemperator 51 is formed, and the attemperator 51 is controlled by the temperature controller 53 so that the temperature detected with a temperature sensor 52 turns into a predetermined constant temperature.

[0062] The various solution technique for compensating the fault that there are many noises is shown, and below drawing 15 is [ that the edge of an image with low infrared image / which is obtained by the

infrared camera 13 / contrast is gently-sloping (a boundary is indistinct), and ] a degree. (1) - There is the solution technique of (5).

[0063] (1) Change presentation (display) concentration based on concentration distribution of an infrared image (the image transformation which is not influenced by the scene becomes possible).

(2) Change edge strong metering based on infrared edge reinforcement (profile emphasis of only low contrast bodies, such as a white line, is attained, the effectiveness of an optical illusion is aimed at and the improvement in contrast beyond traffic light information is attained).

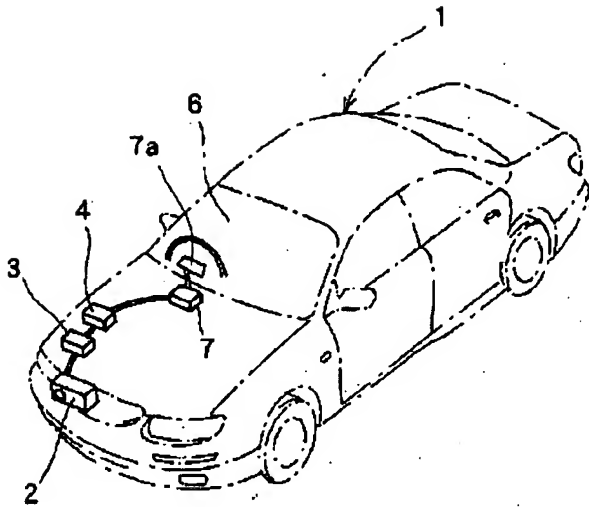
(3) Display a specific body alternatively based on the processing result of a visible-ray image (low contrast bodies, such as a white line, are stabilized, a display becomes possible, and the display of color information, such as a signal and an indicator, is attained).

[0064] (4) Display a specific body alternatively based on the distance information from a laser radar (the improvement in contrast by which low contrast bodies, such as a halt car, were stabilized is attained).

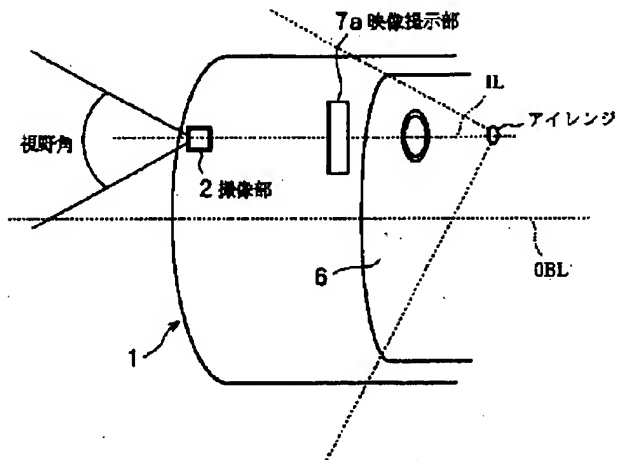
(5) Display a specific body alternatively based on the information from a sensor that external environments other than a camera are detected (for example, the processing whose wet road surface also makes concentration of a white line bright is attained).

[0065] First, drawing 15 - drawing 17 are described above. The solution technique of (1) is shown and it is made to change the presentation image to display 7a based on concentration distribution of an infrared image. That is, as shown in drawing 16, after carrying out flattening of the gray level histogram of the subject-copy image shown in drawing 15, as logarithmic transformation is carried out and it is shown in drawing 17, it has been made to show gamma conversion or the image which suited the property of an operator's (human being) eyes (display).

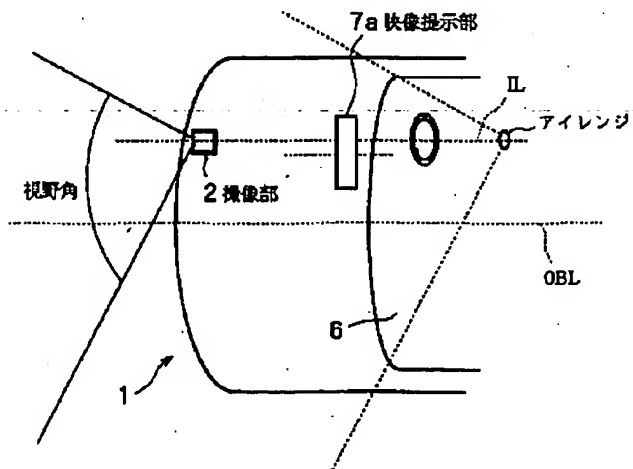
[0066] Drawing 18 - drawing 22 are described above. The solution technique of (2) is shown. That is, secondary differential images as shown in drawing 19 are obtained from the subject-copy image of the infrared image shown in drawing 18. And the images shown in drawing 18 and drawing 19 are added, and the synthetic image as shown in drawing 20 has been obtained. The example of a setting of the filter which performs secondary differential is shown in drawing 21 or



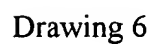
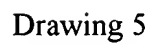
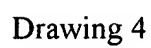
Drawing 1

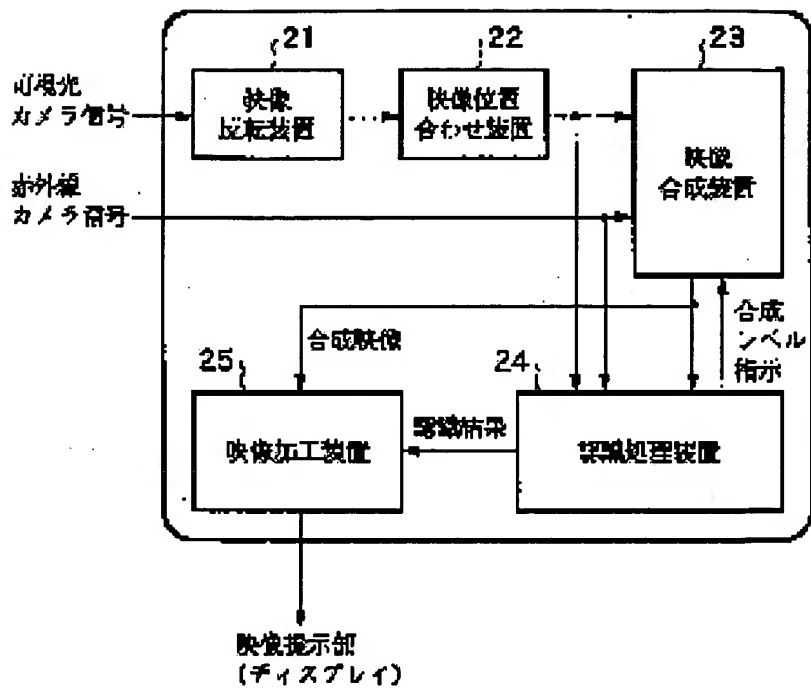


Drawing 2

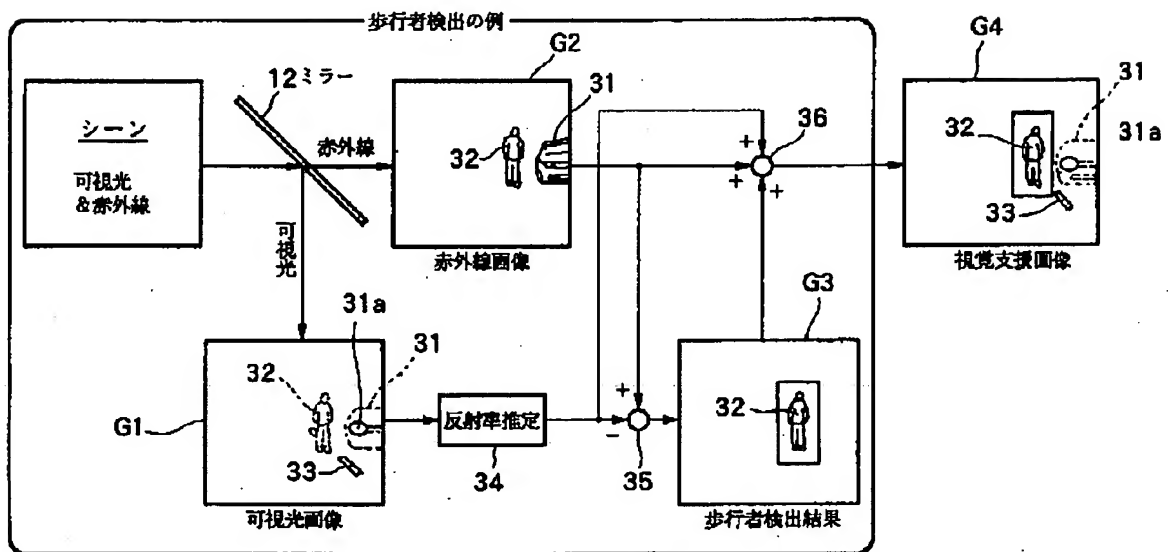


Drawing 3

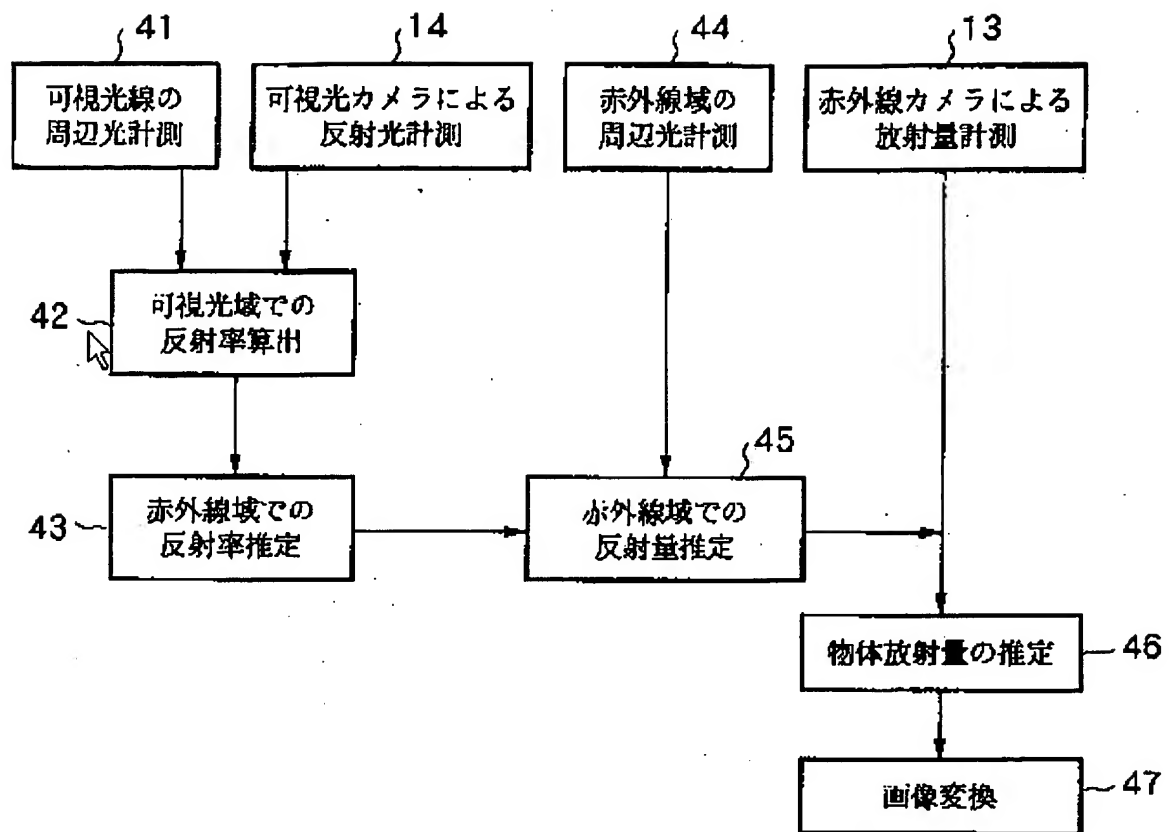




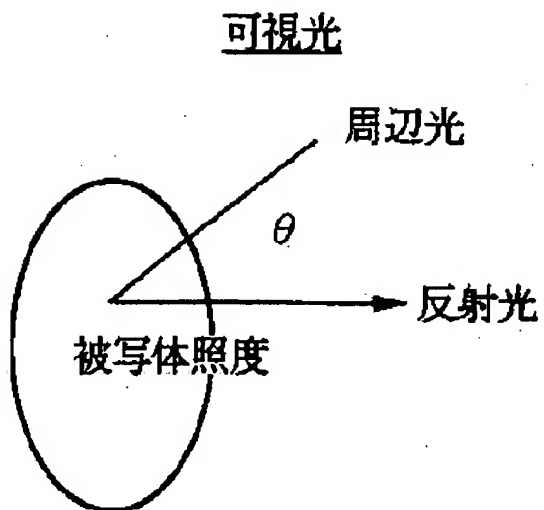
Drawing 7



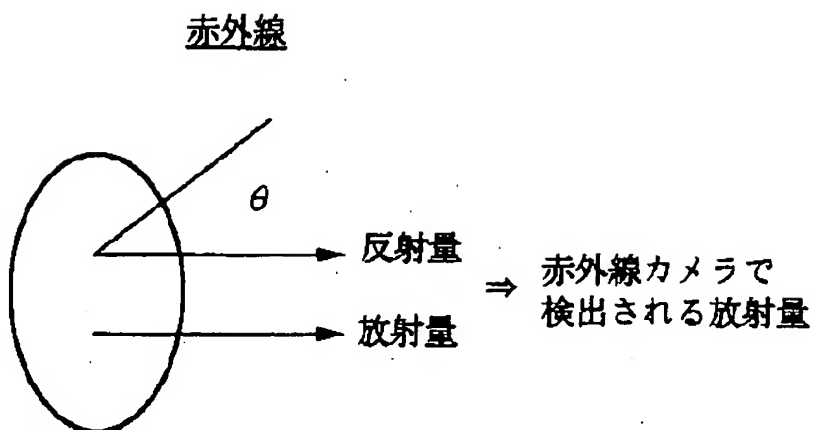
Drawing 8



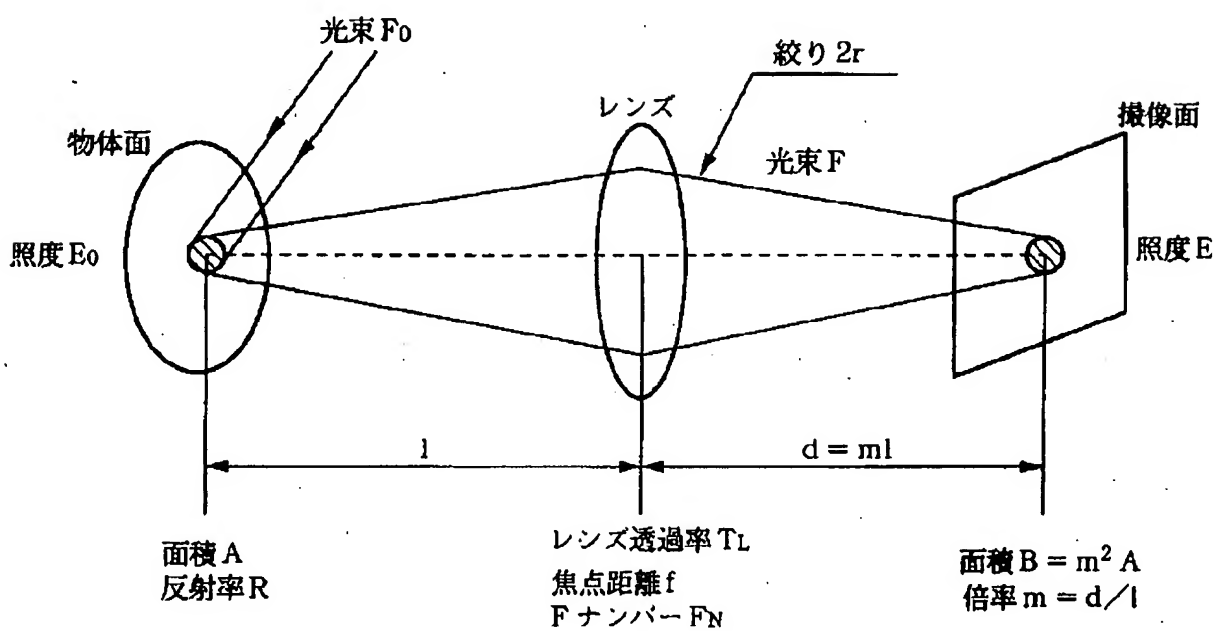
Drawing 9



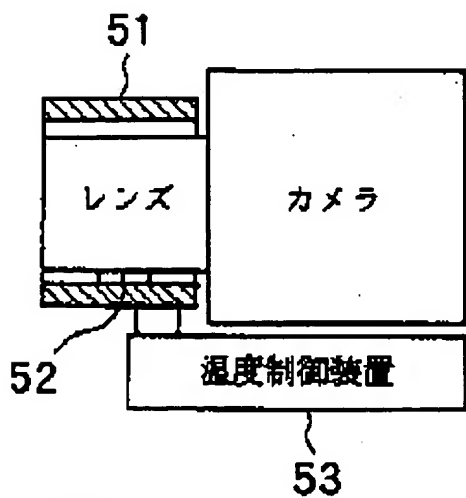
Drawing 10



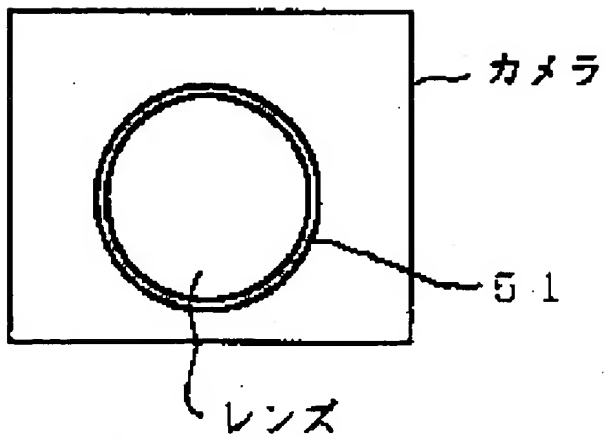
Drawing 11



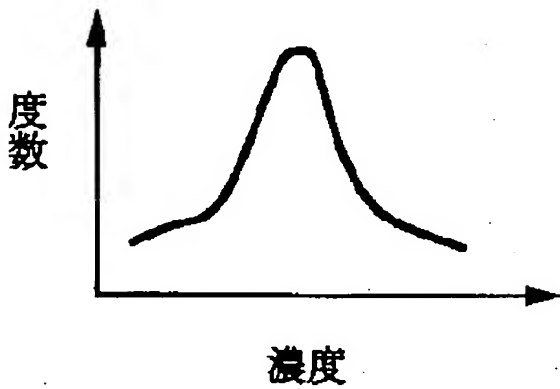
Drawing 12



Drawing 13

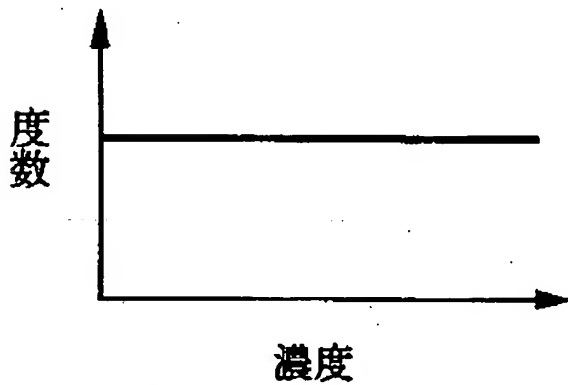


Drawing 14



濃度ヒストグラム

Drawing 15

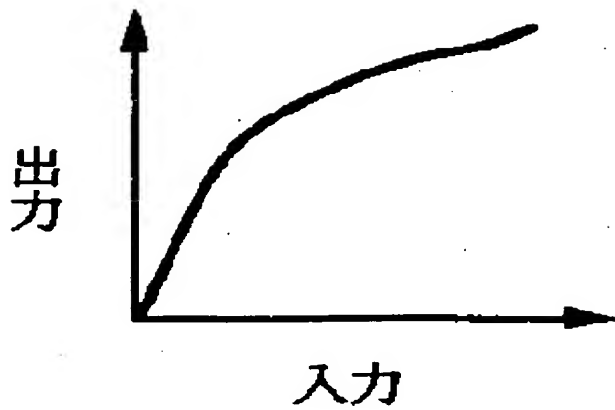


濃度ヒストグラム



濃度の偏りを低減する  
濃度変換処理

Drawing 16

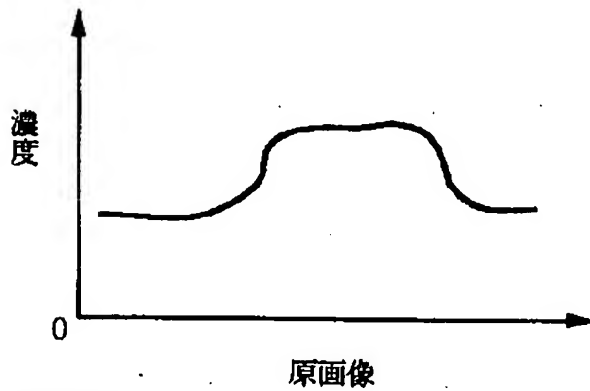


濃度変換特性

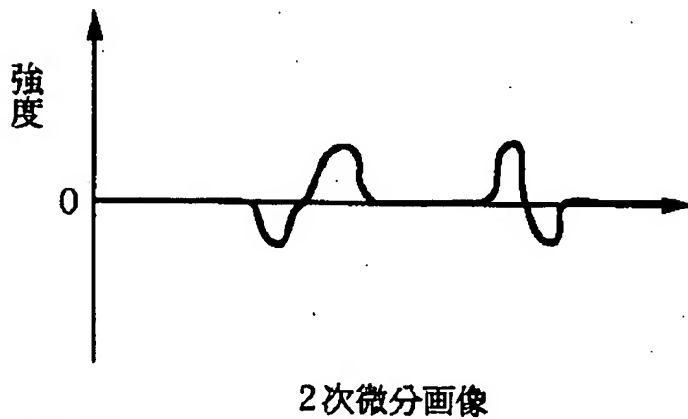


ドライバの眼の特性に  
合わせる処理

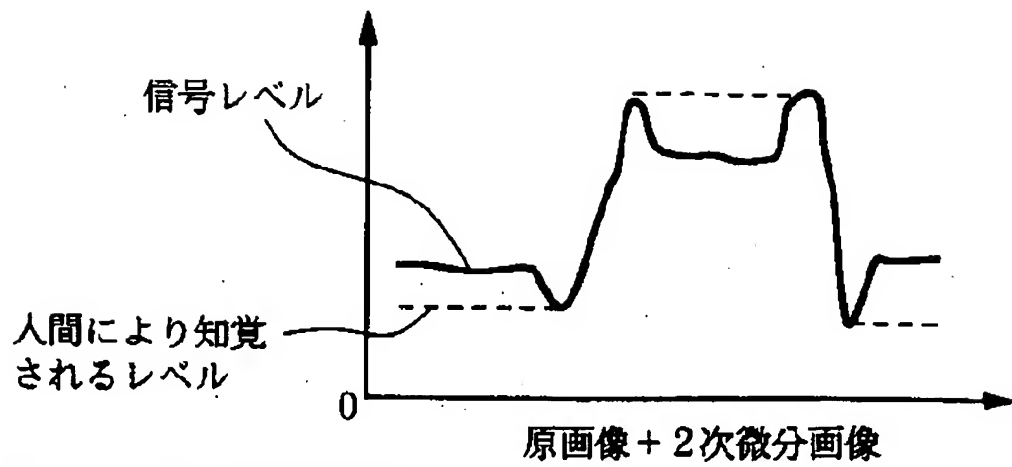
Drawing 17



Drawing 18



Drawing 19



Drawing 20

0	-1	0
-1	4	-1
0	-1	0

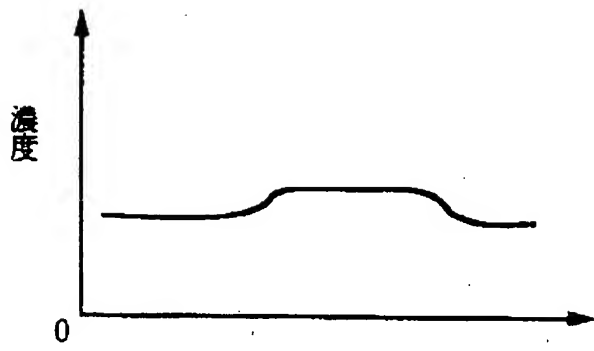
3 × 3

Drawing 21

-1	-1	-1	-1	-1
-1	0	0	0	-1
-1	0	16	0	-1
-1	0	0	0	-1
-1	-1	-1	-1	-1

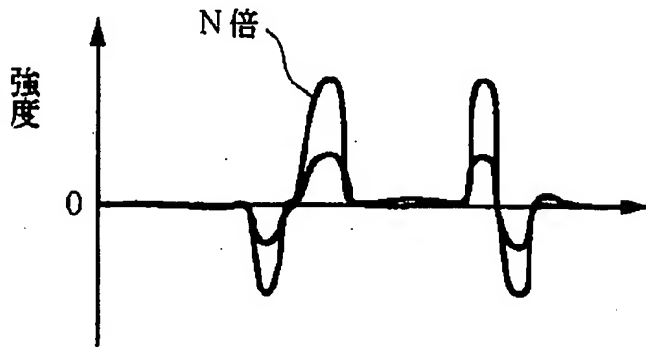
5 × 5

Drawing 22



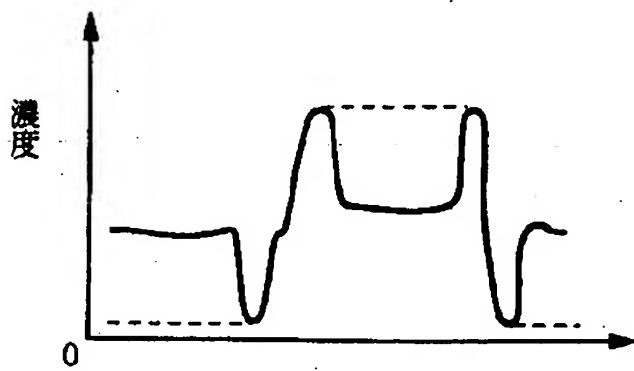
原画像

Drawing 23



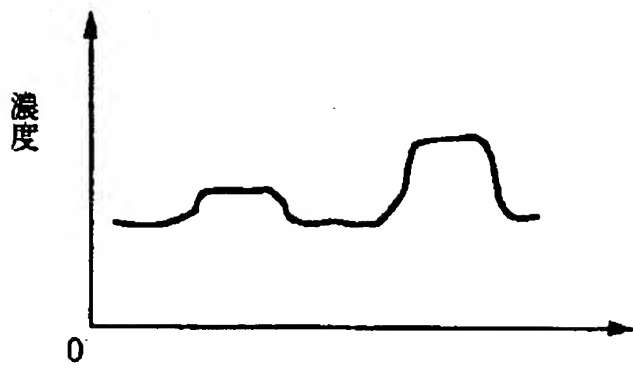
2次微分画像

Drawing 24



原画像 + 2次微分画像  $\times N$

Drawing 25

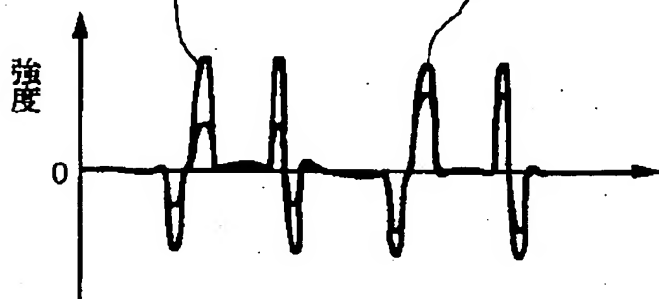


原画像

Drawing 26

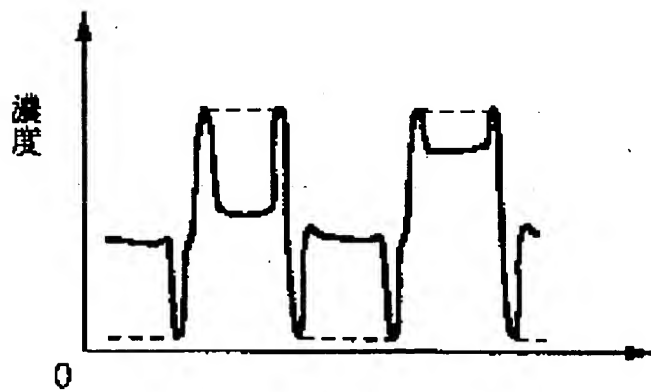
強度に応じて M 倍

強度に応じて N 倍



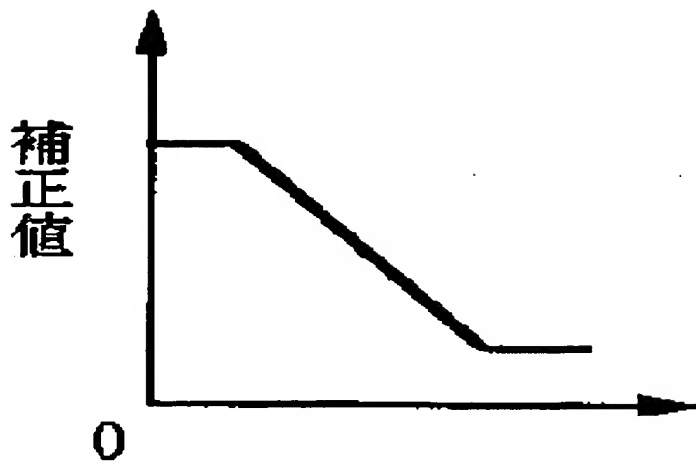
2 次微分画像の補正  
この場合、 $M > N$

Drawing 27



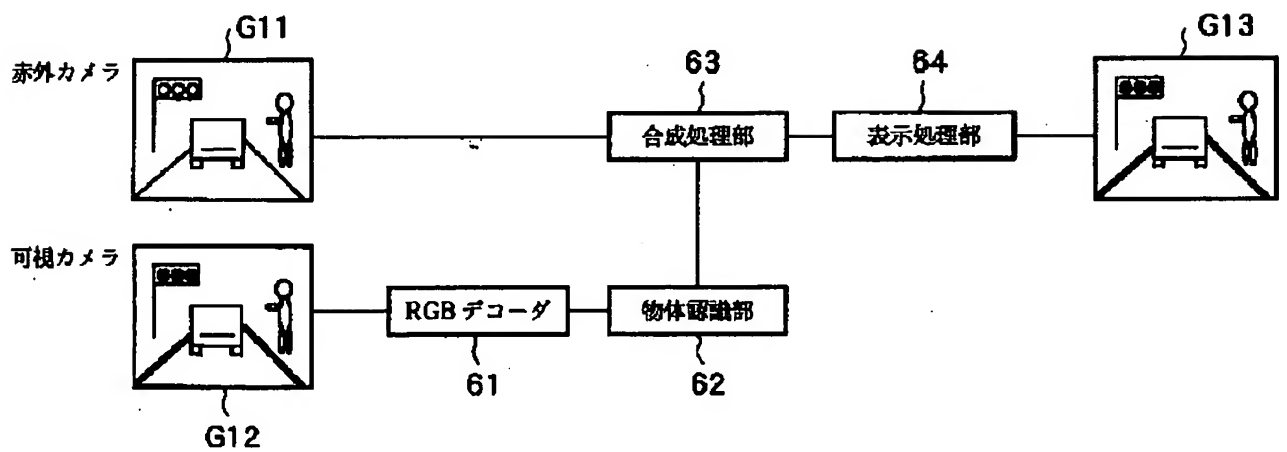
原画像 + 2 次微分画像  $\times (M, N, \dots)$

Drawing 28

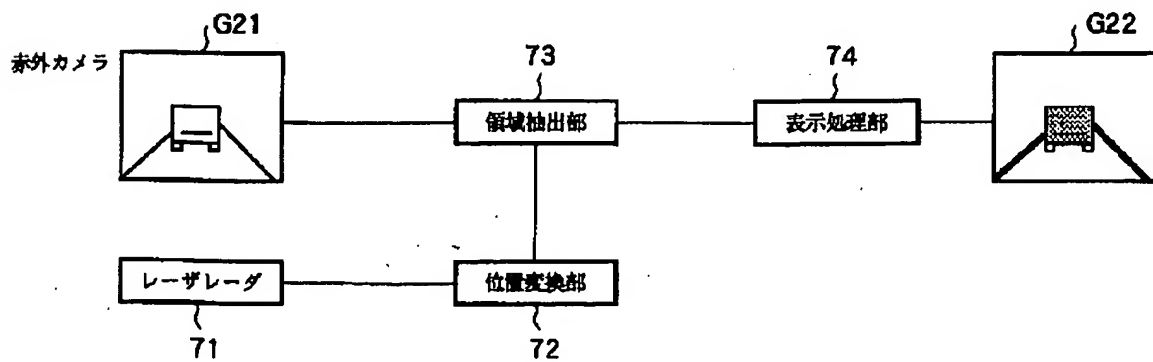


## 強度(2次微分値)

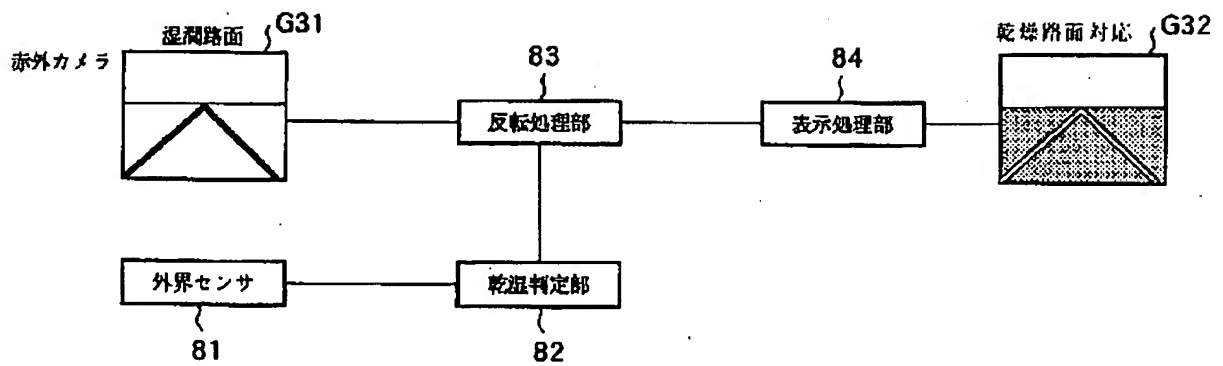
Drawing 29



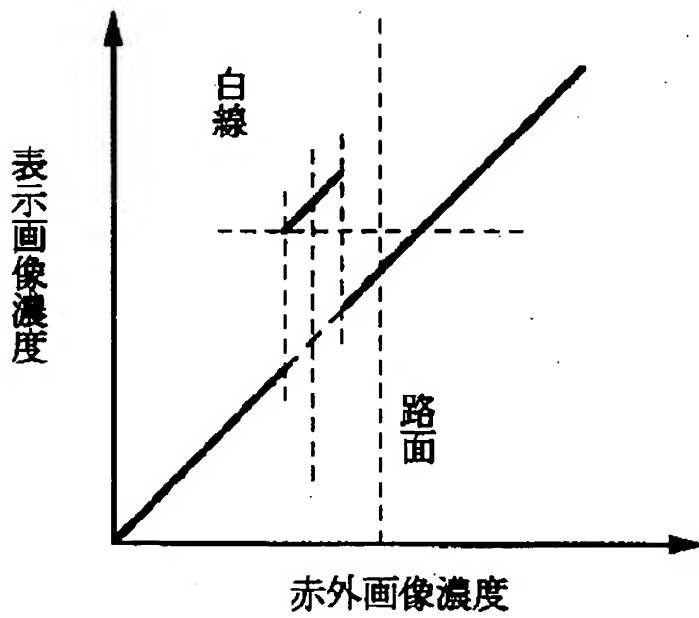
Drawing 30



Drawing 31



Drawing 32



湿潤路面と判定された場合の表示処理  
Drawing 33